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Comparison of video laryngoscopy and direct laryngoscopy for inexperienced pediatric residents

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Abstract

Aim: Recent advances in video technology and fiber optic systems have resulted in the development of new intubation tools and technologies such as video laryngoscopes. It has been shown that as the number of endotracheal intubation attempts with conventional laryngoscopy increases, complications also increase. The aim of this study was to determine the factors affecting the successful use of video laryngoscopy on a child manikin and to compare the success rates of direct laryngoscopy and video laryngoscopy.

Material and Methods: Our study was carried out on a child manikin in the medical skills laboratory. The success rates of direct laryngoscopy, video laryngoscopy and repetitive video laryngoscopy in the hands of experienced and inexperienced, trained and untrained users were compared by comparing the time to visualize the vocal cords and the rates of successful intubation at the first attempt.

Results: A significant difference was found between conventional direct laryngoscopy and video laryngoscopy in terms of glottic view times ($p<0.001$). While there was no significant difference in the success of direct laryngoscopy between the experienced and inexperienced participant groups, glottic view time was significantly lower in the experienced group ($p=0.061$, $p=0.005$, respectively). It was determined that trained participants had a shorter time to see the vocal cords ($p=0.015$).

Discussion: Since the use of video laryngoscopy after training in inexperienced people significantly reduces the time to see the vocal cords, video laryngoscope should be available and training should be given before use, especially in places where inexperienced pediatricians work intensively.

Keywords

Video Laryngoscopy, Intubation, Airway, Pediatric Emergency

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Introduction

The difficulty of intubation increases in pediatric patients due to the presence of hypertrophic adenoids, tonsils, and narrow airways. For these reasons, difficult airway and intubation complications are more common in children compared to adult patients [1]. Video laryngoscopes are a different laryngoscopy method that allows an indirect vision through an optical system placed at the tip of the blade [2]. While this method allows the operator to view the glottis closely on a monitor screen without aligning the oral, pharyngeal and tracheal axes, it also eliminates the requirement for cricoid pressure and external laryngo-pharyngeal maneuver during intubation with the traditional method [3]. In addition, it allows the recognition of anatomical structures and external laryngeal manipulation, and the correct placement of the endotracheal tube by using the laryngoscopic view shared by an inspector other than the airway manager during intubation [4]. It has been shown that complications increase as the number of classical laryngoscopy and endotracheal intubation attempts increase in difficult airway management [5]. Video laryngoscopy assisted tracheal intubation devices have become an alternative to traditional laryngoscopes in recent times. Video laryngoscopy is preferred as the first approach in patients with difficult airway [6]. It is known that a successful direct laryngoscopy requires education and experience [7]. However, it is quite possible that many airline managers are not fully familiar with the operating mechanics of these devices, as they are not in routine use and are not available at all centres; It is vital to know not only the restrictions imposed by the devices, but also for their use [8]. Due to the differences in years, emergency and intensive care conditions, and airway difficulties in studies conducted to date, a complete comparison between direct and video laryngoscopy use has not been made. In order to provide optimal conditions in an emergency, pre-training and rehearsal are required [9]. The aim of this study was to determine the factors affecting the successful use of video laryngoscopy on a child manikin and to compare the success rates of direct laryngoscopy and video laryngoscopy.

Material and Methods

Study Design

The study was approved by the local ethics committee (approval number: 2021/561). Resident pediatricians who received 2 years of pediatric training and had 50 or more intubations participated in this study. Experienced airway manager, those who have not completed two years and intubated less than 50 years, was accepted an inexperienced airway manager. Pre-intubation video laryngoscopy training was given to the participants who volunteered for the training by a pediatric emergency specialist.

Our study was carried out on a child model in the medical skills laboratory of our institution. The model is a pediatric intubation trainer (255-00001)® (Photo). The size of the model is compatible with a 6-year-old patient. Thus, equal intubation difficulty was provided for all participants in the study. All intubations were performed with a 5 mm cuffed endotracheal tube (ETT). The cuff was inflated with a 5 ml syringe. Number two curved blades were used in the study. The study was carried out in five separate sessions. First, participants were intubated with conventional direct laryngoscopy. Success rates and vocal cord visualization times were recorded. Then, intubation was performed with video laryngoscopy. Correct placement of the endotracheal tube by the participants was considered successful intubation, and correct positioning was confirmed by inflating the model's lungs with the aid of a balloon valve mask. Finally, video laryngoscopy was performed again.

Participants were divided into groups as those who received video laryngoscopy training and did not, and those who were experienced and those who were not. The success rates of direct laryngoscopy, video-laryngoscopy, and repeated video-laryngoscopy in experienced and inexperienced, trained and untrained users were compared by comparing vocal cord visualization times and successful intubation rates at the first attempt.

Statistical Analyses

Statistical analysis was performed using IBM SPSS Statistics for Windows software (version 22.0; IBM Corp. Armonk, NY, USA). The Shapiro–Wilk test was used to assess the normality of the parametric data. Descriptive statistics are given as number and median (25th–75th percentile). The Chi-Square test was used to compare categorical variables. The Wilcoxon test was used to compare two paired groups, and the Friedman test was used to compare more than two paired groups. The Mann–Whitney U test was used to compare non-normally distributed groups. A p-value < 0.05 was considered statistically significant.

Results

A total of 67 participants were included in the study. Thirty-three (49.3%) of the participants were experienced in intubation and 34 (50.7%) were inexperienced. A total of 201 intubations were performed. A significant difference was found between conventional direct laryngoscopy and video laryngoscopy in terms of vocal cord visualization times ($p<0.001$). Similarly, a significant difference was found between video laryngoscopy and repeated video laryngoscopy in terms of vocal cord visualization times ($p<0.001$).

While 30 (90.9%) of the experienced participants were successful in conventional direct laryngoscopy, the remaining 3 (9.1%) were evaluated as unsuccessful. In inexperienced

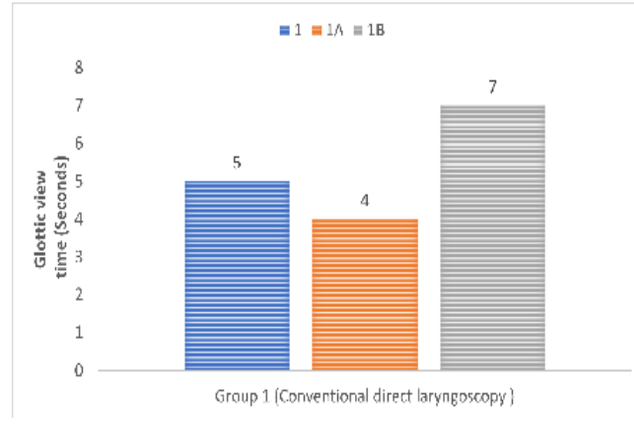

Figure 1. Glottic view time among the conventional direct laryngoscopy users. Group 1:all participants, Group 1A: experienced users, Group 1B: inxperienced users

participants, these rates were 25 (73.5%) and 9 (26.5%), respectively. While there was no significant difference in the success of direct laryngoscopy between the experienced and inexperienced participant groups, vocal cord visualization time was significantly lower in the experienced group (p=0.061, p=0.005, respectively) (Figure 1). Table 1 shows the effect of the experience factor on laryngoscopy success.

There were 40 (59.7%) participants who received video laryngoscopy training and 27 (40.3%) who did not. There was no difference in success rates between those who received video laryngoscopy training and those who did not. However, it was determined that the participants who received the training had a shorter time to see the vocal cords (p=0.015) (Table 2) (Figure 2).

In repeated video laryngoscopy attempts, it was seen that the technical or personal characteristics of the participants did not affect the application, and all participants saw the vocal cords at similar average times, all participants were successful when they performed video laryngoscopy for the second time (Figure 3). After repeated trials, all participants were able to successfully use the provided video laryngoscopes.

Discussion

Video laryngoscopy can be considered a more successful application than traditional video laryngoscopy, especially when training is provided for pediatric residents who will

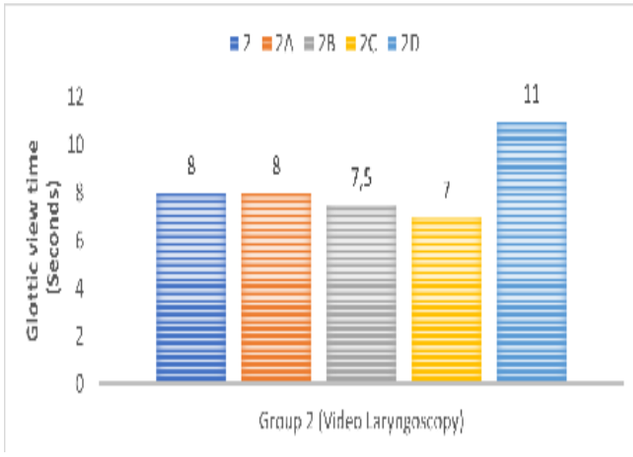

Figure 2. Glottic view time among the video laringoscopy users. Group 2: All users, Group 2A: experienced users, Group 2B: inexperienced users. Group 2C: educated users, Group 2D: uneducated users

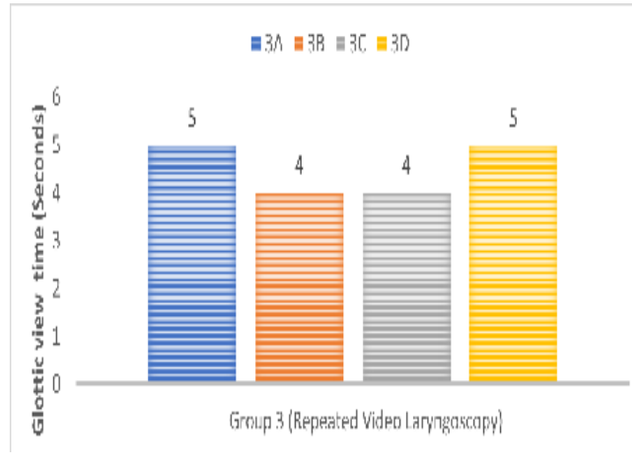

Figure 3. Glottic view time among the repeated video laryngoscopy users. Group 3: All users, Group 3A: experienced users, Group 3B: inexperienced users. Group 3C: educated users, Group 3D: uneducated users.

Table 1. Comparison of laryngoscopy success rates according to participant experiences

	Experienced participants		Inexperienced participants		p-value
	Successful n,(%)	Unsuccessful n,(%)	Successful n,(%)	Unsuccessful n,(%)	
Conventional direct laringoscopy	30, (90.9%)	3, (9.1%)	25, (73.5%)	9, (26.5%)	0.061
Video laringoscopy	30, (90.9%)	3, (9.1%)	30, (88.2%)	4 (11.8%)	0.517
Repeated video laringoscopy	33, (100%)	0, (0%)	34, (100%)	0, (0%)	-
Total	33		34		

n: number of patients, *p < 0.05 (statistically significant)

Table 2. Comparison of glottic view and intubation success rates among the laryngoscopy types

	Conventional Direct Laringoscopy	Video Laringoscopy	Repeated Video Laringoscopy	p-value
Glottic View Time, (second), (IQR)	5 sn (4.0-8.0)[a]	8 (5.0-14.0)[b]	5 (3.0-7.0)[a]	<0.001*
Intubation Success Rate, (Successful/ Unsuccessful)	(55/12)[a]	(60/7)[a]	(67/0)[b]	0.002*
Glottic View Time, second (IQR)				
Experienced	4 (4-7) †	8 (5-15)	5 (3.75-6.5)	0.005†
Inexperienced	7 (4.75-12)	7.5 (5-13.5)	4 (3-7.5)	
Video Laringoscopy Glottic View Time, education status ;				
Educated	5 sn (4.0-8.0)[a]	7 (5-10.75)[a]	4 (3-7)[b]	0.006*
Uneducated	5 sn (4.0-8.0)[a]	11 (6-19)[b]	5 (3-8)[a,c]	<0.001¥
Educated, successful / unsuccessful (n/n)		37/3		0.286
Uneducated, successful / unsuccessful (n/n)		23/4		

n: number of patients, IQR: interquartile range, *†¥ p < 0.05 (statistically significant), different letters on the same line represent statistically different groups

work in the practice of pediatric intubation, or when the participant gains experience. Ozawa et al. in a study by 27 experienced neotologists, it was shown that the use of video laryngoscopy increased the laryngoscopy easiness score [10]. We found that pre-intubation training did not affect the success rate of intubation, but reduced the time to visualization of the vocal cords. In light of these data, video laryngoscopy method, which is applied with training instead of traditional direct laryngoscopy, seems to be more suitable for intubation in pediatric cases. At the same time, in the study conducted by Adil Omar et al. with 100 inexperienced medical assistant students, it was reported that a higher number of successful intubations, and shorter intubation times were achieved with video laryngoscopy compared to the traditional method [11]. When evaluated according to the previous experience of the participants, it was seen that experienced and inexperienced participants in pediatric intubation did not differ in terms of intubation success rates, but experienced participants visualized the vocal cords faster. When video laryngoscopy was performed for the first time and again, it was not significant whether there was previous intubation experience or not. People who received video laryngoscopy training, had shorter video intubation time, but when the second application was performed, those who did not receive training achieved the same success rate as those who received training.

In comparative studies performed with C-Mac laryngoscope and direct laryngoscopy, it has been reported that C-Mac is more successful in both normal and difficult airway management compared to direct laryngoscopy [12-14]. In a retrospective study by Sakles et al., it was shown that video laryngoscopy in the emergency department led to a higher success rate and fewer esophageal complications [15]. Similarly, in our study, when inexperienced participants were given video laryngoscope experience, a very high success rate was achieved, while all participants achieved successful intubation during repeated attempts.

In the retrospective study by Matthew et al. in 2016, covering a 10-year period in the pediatric emergency, 452 patients were included, and approximately half of the patients who underwent video laryngoscopy and direct laryngoscopy were compared, and they found no significant difference between direct laryngoscopy and video laryngoscopy in terms of intubation success and complications [16]. The reason for this finding was that the opening of the oral cavity decreased during intubation using a video laryngoscope, and the operable cavity of the oropharynx was also narrowed, and the angle adjustment of the catheter in the oropharyngeal cavity became more difficult. In some studies on the adult emergency, it has been shown that the rate of successful intubation at the first attempt increased when video laryngoscopy is used compared with direct laryngoscopy [17,18]. In our study, similar to the results of Matthew et al.'s study, there was no significant difference between video and direct laryngoscopy at first intubation attempts, but when the participants gained experience, it was seen that a hundred percent success rate was achieved with video laryngoscopy.

Szarpak et al. compared the efficiency of endotracheal intubation between the Macintosh and the Intu Brite video laryngoscope with inexperienced participants, the superiority of the video laryngoscope was not demonstrated. However, the success of the first intubation was found to be higher in the Macintosh [19]. Hendrick et al. in a study conducted on inexperienced participants, it was shown that video laryngoscopy gave better results in difficult airway stimulation. In the study of Malik et al. with experienced anesthesiologists, when the success rate of traditional laryngoscopy with three different video laryngoscopes was compared, the overall success rate of video laryngoscopy methods was 96.7%, the traditional success rate was 90% [14,20]. In a study conducted on 360 patients in China, it was reported that there was no difference in the use of video laryngoscopy in airway management that is not difficult [21]. In our study, the visual time of the vocal cords decreased significantly in video laryngoscopy with repeated experience, and all participants had a successful repeat attempt. The success of all participants in the second video laryngoscopy trial indicates that the success of the application can be quite high after gaining experience in video laryngoscopy.

In a national survey conducted in England, in public hospitals, while video laryngoscopy is common in 91% of anesthesia departments and 50% in intensive care units, the rate of use of video laryngoscopy in pediatrics and emergency departments in private hospitals is very low [22]. In 2015, the Difficult Airway Society (DAS) recommended in the difficult intubation guide that video laryngoscopy training should be given and available in all intubated areas [23]. In our study, we found that the duration of visualization of the vocal cords decreased significantly after training in inexperienced pediatric residents. According to these data, video laryngoscopy should be available and its use should increase in pediatric hospitals.

Conclusion

As a result, since the use of video laryngoscopy after training in inexperienced persons significantly reduces the time to see the vocal cords, video laryngoscope should be available and training should be given before use, especially in places where inexperienced pediatricians work intensively.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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